INFANT MORTALITY IN INDIA

AN OVERVIEW

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INFANT MORTALITY IN INDIA: AN OVERVIEW

Anrudh K Jain & Pravin Visaria

BACKGROUND

The infant mortality rate has in recent years been recognized as an excellent summary index of the level of living and socio-economic development of a country. This recognition has inspired international organizations as well as national governments to intensify their efforts to lower infant mortality and raise the level of child survival. Following the Alma Ata Declaration of 1978 to ensure 'Health for All' by 2000 AD, the Government of India has adopted the national goal of halving the prevailing level of infant mortality (from about 120) to 60 by 2000 AD. The Sixth and the Seventh Five-Year Plans of India have aimed at nation-wide programs to realize this goal. Different versions of the '20-point program' listing the high priority goals of the government, enunciated by the late Prime Minister Indira Gandhi as well as Prime Minister Rajiv Gandhi, have included 'a rapid improvement in the conditions of women and children' as a key component.

The programs to reduce infant mortality in India have been guided largely by health professionals who are convinced that the available low-cost technology is adequate to achieve the targets.

Indian social scientists, who have generally taken only limited interest in research relating to health and mortality, have often been skeptical about the feasibility of realizing the goal of halving the infant mortality rate (IMR) by 2000 AD because they view it as an epitome of the socio-

economic milieu (which is improving far too slowly). The skepticism persists despite the well known experience of the 1950s when the introduction of antibiotics and the campaign to eradicate malaria mainly through spraying of DDT were surprisingly successful in lowering the death rate in a short period of time.

The skepticism of the social scientists is supported partly by the apparent apathy of the people, particularly those dispersed over 570,000 villages in the countryside, about the level of infant mortality. According to the 1981 Census, in India as a whole (excluding Assam), the average population of a village was only 911. About 73 per cent of the villages, accounting for about 32 per cent of the rural population, had less than 1,000 persons each. An additional 17 per cent of the villages with a population of between 1,000 and 1,999 persons accounted for 26 per cent of the rural population. In the small villages, many villagers hardly see or hear of more than six deaths of infants even when the IMR is 150 deaths per 1,000 births and the birth rate is 40 births per 1,000 population. Unaware of the success of other countries or even the state of Kerala within India in lowering the IMR to less than 50, they fatalistically accept the deaths of infants almost as the potters accept the breakage of some of the pots fabricated by them as inevitable. The fact that the recent level of the IMR is much lower than what used to prevail only about a generation ago has probably induced a certain sense of complacency about the pace of decline in the IMR.

SUBSTANTIVE FINDINGS

Pace of Decline:

In substantive terms, the papers presented in this volume throw some light on the pace of decline in the IMR during the past 15 years relative to the earlier years and also on the question of the feasibility of a rapid decline in the future. The review of literature highlights the fact that the IMR of 125-130 reported by the Sample Registration System (SRS) during the 1970s was half that estimated for the 1920s (240). We believe that the estimates of census actuaries understated the true level of infant mortality during the 1920s and also the 1940s. The estimates of an IMR of the order of 200 or 225 during the 1940s (Coale and Hoover, 1958) are not really implausible.

The official life tables for 1951-60 and 1961-70 were based on unduly low infant mortality rates. The former used the infant mortality rates reported by the National Sample Survey on the basis of its 14th Round during 1958-59. The SRS crude death rates for 1965-67 were significantly above those estimated by the NSS for 1958-59 for nine of the 13 states for which both sources provided some numbers. (For two other states, the estimates were close.) Since there is no reason to believe that the level of mortality had risen between 1958-59 and 1965-67, death rates based on the NSS had to be considered underestimates.

The IMR values for 1961-70 were obtained by linear interpolation between the IMR for 1951 and the SRS values for 1968-70 (for three years for rural areas and for the last year for urban areas). The q(1) value used in the

1961-70 life tables was low both because of the low values assumed for the 1951-60 life tables as well as the under-estimation of the level of the IMR in the initial years of the SRS. The validity of the SRS-based estimates of the IMR for the early years of the SRS can be questioned because they were lower than the survey based estimates for that period: the indirect estimates based on the NSS of 1966-67 (21st Round) suggests a q(1) of between 156 and 171 for 1961 and the ORG survey conducted during 1969-70 indicates a q(1) of between 144 and 156 for the mid-1960s. (The higher values are based on the West model and the lower values on the South model of Coale-Demeny life tables.) In comparison, the SRS values for rural areas in 1968, 1969 and 1970 were 137, 140 and 136 respectively. The urban rate for 1970, the first year for which it was available, was 90, yielding an overall rate of 129.

The SRS-based surveys conducted by the Office of the Registrar General during 1972 and 1979 imply q(1) values of 125-131 for 1968 and 121-126 for 1975, respectively. (Again, the South and the West models yield the lower and the upper values of estimates.) These values are lower than the SRS estimates of 137 for 1968, and 140 for 1975. These comparisons may illustrate the inherent limitations - a downward bias - of survey-based estimates. This downward bias may be due in part to the exclusion of those deaths reported in surveys to have occurred at the exact age of 12 months. Some of these deaths must have occurred before the age of 12 months and, therefore, should be included in the numerator of survey-based IMRs. According to our best judgement, the data shown in Table 1.2 indicate a probable

trend in the IMR. After an initial, rather rapid decline up to 1961, the IMR is presumed to have fallen at a slower rate. The pace of decline has accelerated after 1975 because of the implementation of the maternal and child health programs, discussed below.

Despite the well known limitations of the public health infrastructure, its expansion, in our judgement, has helped to control a fair proportion of infant and child deaths. To note a few key statistics, the number of primary health centres (initially called 'primary health units') has increased from none in 1951 to 7,284 in 1985. An additional 83,000 subcenters (usually one per 10,000) were also set up between 1971 and 1985. Beginning with the Sixth Plan (1980-85), the goal has been to set up one Primary Health Center (PHC) per 30,000 population and a subcenter per 5,000 population (in tribal areas, where population is scattered, a PHC is to cater to 20,000 persons and a subcenter to 3,000 persons). In 1977, about 25 per cent of the villages had a dispensary within the village or within 3 kilometers. (Villages which have a hospital or a PHC are presumed to have a dispensary). Since these amenities are initially set up in relatively large villages, the proportion of households and population with physical access to a dispensary would be larger. The sanctioned number of health personnel working in the PHCs and the subcenters has also increased over the years. According to the census data, the number of health functionaries (including physicians, nurses, midwives, health visitors, vaccinators and inoculators and other related assistants) stationed in rural areas has also increased in absolute numbers. This increase, however, has

not been much faster than the growth of population. (The figure per 1,000 population was 0.53 in 1961 and 0.55 in 1981.) Further, the persistent problems of poverty and inadequate transport and communications limit the access to medical care for a sizable proportion of needy cases. Overlooking the inter-state differences, the remarkable expansion of the health infrastructure in rural India has not increased the density of available health personnel.

A better understanding of factors contributing to the observed decline in infant mortality can be achieved by organizing the discussion within an analytical framework consisting of proximate and other determinants of infant mortality (see Nag, Chapter 14, for a review of various frameworks). The following discussion is organized under three headings: proximate factors, maternal factors, and household and community-level factors.

Proximate Factors:

The six proximate factors, identified by the senior author in Chapter 3 are:

1. non-medical care during the prenatal period;
2. medical care during the prenatal period;
3. care at birth;
4. non-medical factors during the postnatal period;
5. preventive medical care during the postnatal period; and
6. curative medical care during the postnatal period.

A broadening of this list to include 'genetic constitution of infant,' or 'reproductive health of mother at the time of conception,' as proposed by Nag (Chapter 14) is not warranted by the current state of the art in terms of data collection

and remedial action. Moreover, their potential contribution to infant mortality at its current high level is likely to be relatively small. Maternal factors are treated separately because, as discussed in Chapter 3, they do not directly affect the risk of infant death.

Prenatal Care: The Traditional Concerns:

This framework of analysis focuses on the immediate factors that could ensure the survival of the fetus or the baby, Prima facie, the distinction between the prenatal, natal and postnatal period seems to follow the widespread practice in the developed countries or in urban centers of India to consult physicians as soon as a pregnancy is suspected. However, the hoary Indian tradition reportedly prescribed a specific ceremony during each month of pregnancy to safeguard the fetus and/or the pregnant woman, For example, Dubois (1897: 341) noted that 'when a Brahmin's wife becomes pregnant there are endless ceremonies to be performed, some indeed for each separate month...' Four ceremonies that we have been able to identify so far include two that were performed only during the first pregnancy. One (garbhadhan) was performed during the first month after the first pregnancy became known. (A variant of it is said to be performed prior to intercourse to ensure good procreation.) Another ceremony, performed during the fourth, sixth or the eighth month of pregnancy, involving parting of hair, was intended to purify and protect the fetus. A ceremony performed during the first (or second or the third) month of pregnancy aimed at begetting a son; but another ceremony during the third month of pregnancy sought to protect the fetus against abortion.

The religious texts such as the Manusmriti recommended these ceremonies for the higher castes alone (the twice-born). Also, there were temporal and spatial and group-specific differences in their actual practice. However, the recommended ritual of giving a newborn baby honey and ghee (with traces of gold or with a golden spoon) prior to the cutting of the umbilical cord is presumably the origin of the widespread practice of prelacteal feeds (see Visaria, Chapter 2).

Quite apart from the ceremonial rituals, the Indian system of medicine is said to have evolved a special branch relating to various stages of pregnancy. A different diet is prescribed for successive months of pregnancy to ensure a relatively easy full-term delivery. The use of various herbs was prescribed to prevent a spontaneous abortion. Folklore also recommends that the longing of a pregnant woman for different types of food should normally be satisfied. Properly interpreted, the nature of food longed for was supposed to indicate the character of the child and its potential achievement(s).

Quite probably, the proportion of Indians following the traditional prescriptions was limited even at the time of Independence in 1947 and it has declined since then. However, a substantial fraction of pregnant women in India still follow the practice of going to their parents' home for (at least) the first delivery. The rationale of this tradition lies in the relatively freer communication between a daughter and her mother than between a daughter-in-law and a mother-in-law as well as the likelihood that a pregnant woman would be able to get more rest in her parental home than in the house of her in-laws.

Khan's study (Chapter 7) in Uttar Pradesh seeks to shed some light on the workload of pregnant women through some intensive case studies. The number of cases covered by him in this paper is too small to portray the wide variety of situations that presumably develop according to the age, parity, caste and the educational attainment of the pregnant woman. However, anecdotal evidence is strong that the workload of pregnant women may be a factor influencing her net caloric intake and nutritional status, weight of the baby at the time of delivery, and its survival. While few studies have explored the complex interrelationships, the available evidence is clear that babies born to non-working mothers (Visaria, Chapter 2). Since the work status of the mother is likely to be inversely correlated with the socio-economic status (and the income) of the household, the cause-effect linkages are difficult to disentangle.

A special tabulation of the data relating to 731 births in the Vadu rural health project area, delivered at home, shows that babies born in the house of the mother's parents encountered a lower risk of infant mortality (76) than those born in the house of their parents or father's parents (123), with the difference statistically significant at the 5 per cent level (see Rao and Coyaji, Chapter 6 for the background data). Since the women do not live in the homes of their parents for the entire first year of life of these babies, the precise factors at work are far from clear. The role of the mother-in-law may also be confounded with relatively limited availability of help in the running of the household, particularly if the family is nuclear, or if the bonds with other offshoots of the former extended family are not strong enough to provide the required support.

Prenatal Medical Care:

The tradition of considerable prenatal care of pregnant women notwithstanding, there are reports of extensive anemia and malnutrition among expectant women throughout the country. The maternal and child health (MCH) care program seeks to provide pregnant women with iron and folic acid tablets, primarily during the last trimester of pregnancy. Although a national goal in this respect was spelled out in the Third Five-Year Plan in 1961, the number of expectant and nursing women given 'prophylaxis against nutritional anemia' was 3.7 million in 1975-76 and has risen to 8.4-8.5 million during 1983-84 and 1984-85. Of course, provision of iron and folic acid tablets does not ensure their actual use or elimination of anemia; but the program is indicative of the thrust of MCH activities that have accelerated since about 1974.

This change is even more evident with respect to the immunization of pregnant women with tetanus toxoid, which can effectively eliminate neonatal tetanus as a cause of infant death during the neonatal period. Several estimates indicate that neonatal tetanus accounts for between 30 and 23 per cent of infant deaths in rural and urban areas of Uttar Pradesh (where infant mortality rates have been the highest throughout the period covered by the available SRS data). Tetanus is reportedly an important cause of infant deaths in Andhra Pradesh, Haryana, Tamil Nadu and Orissa as well (see Visaria, Chapter 2). The intensive study of a rural area in Tamil Nadu (Gunasekaran, Chapter 8) and Haryana (Kumar and Datta, Chapter 5) confirms that tetanus accounted for over 10 per cent of at least the neonatal

deaths; and that it could easily be checked in an experimental area. Nationally, the number of pregnant women receiving immunization against tetanus has risen from 0.7 million in 1974-75 to about 9.3 million during 1985-86. Despite the problems of administering these vaccines in the recommended manner, a statistically significant inverse correlation (- 0.65) was observed during 1978 between the estimated percentages of pregnant women immunized against tetanus and the percentage of neonatal deaths attributed to tetanus in the Registrar General's Survey on Infant and Child Mortality during that year (Visaria, Chapter 2).

The decline of nine points in the overall IMR for the entire country estimated by the SRS, from 104 in 1984 to 95 in 1985 after virtual stability for two years in 1983(105) and 1984(104), seems to be attributable partly to the decline of 14 points in the IMR in Uttar Pradesh between 1984 and 1985. A part of this decline in UP is presumably due to the rise in the number of pregnant women immunized against tetanus from 0.4 million during 1977-78 and 0.9 million in 1983-84 to 1.3 million during 1984-85 and nearly 1.5 million during 1985-86.

Admittedly, some of the children protected against the risk of neonatal tetanus will die of other causes. The proportionate decline in the IMR as a result of eradication of tetanus will not equal the percentage of infant deaths attributed to it. However, the prenatal care required to prevent tetanus should be relatively easy to administer in most parts of the country.

Assuming that tetanus immunization should be classified as part of prenatal medical care, the other components of such care include that they are examined by a health professional in the PHC, the subcenter or their homes. It should theoretically be feasible if the village level health workers register all pregnancies and note the characteristics of pregnant women. However, the reality is far from the ideal and the cost of transport to the subcenter or the PHC, the loss of wage, the difficulty of making alternative arrangements to look after the household chores, and the lack of adequate empathy among the health staff, all prevent pregnant women from consulting a health professional until a specific serious problem is identified.

Care at Birth:

Among the factors relating to care at birth are the competence and skills of the attendant to help avoid complications at delivery. While factors like prematurity or low birth weight (malnourishment) will reflect prenatal care factors, neonatal tetanus as well as asphyxia could be a function of the care at birth.

It is a sad fact that 40 years after Independence, except in Kerala, a large majority of rural babies continue to be delivered by untrained birth attendants- mainly relatives. The program of training the dais, launched in the early 1960s, claims to have trained 515,000 dais by 1984 but it has not made much difference in the proportion of births attended by them. The difficulty lies partly in the location of trained dais and their inadequate mobility.

Many complicated cases seek the attention of trained health professionals a little too late, with the result that the infant mortality rates for babies attended by them exceed the corresponding rates for babies born without any trained attention (Rao and Coyaji; Gunasekaran, Chapter 6 and 8, respectively).

Postnatal Non-medical Factors:

Among the postnatal non-medical factors that influence the chances of survival of the newborn, the issues of prelacteal feeds, the timing of initiation of breast-feeding, the duration of lactation and the timing of introduction of supplementary semi-solid food (before or after cessation of breast-feeding) determine the nutritional status as well as the susceptibility or resistance to chances of infection. The practices with respect to these issues are based on folklore and tradition and include the throwing away of colostrum from the breast after childbirth. These matters can be influenced by a well-designed program of disseminating scientific information and education through various mass media. If those designing the educational programs can check the biases resulting from their upper class origins and recognize the constraints within which low-income families operate, such educational efforts can be expected to play a useful role.

A deep-seated problem in this respect is the discrimination against daughters. Some communities in certain parts of India, particularly United Provinces, Punjab, Rajasthan, Jammu and Kashmir, as well as parts of Gujarat (O'Malley, 1968: 356-357) are known to have killed their daughters at least up to the

mid-19th century. The British rulers tried to curb this gruesome practice. Recently, Venkatramani (1986), an investigative journalist, has brought to light the practice of female infanticide among Kallars, a community of landless labourers in the Madurai district of Tamil Nadu. The two prospective studies included in this volume, however, do not find any evidence of excess infant mortality among female babies in two blocks of Madurai district and in four community development blocks of Madurai and Coimbatore districts (Gunasekaran, Ramanujam, Chapters 8 and 9). The available SRS data for the period 1968-78 have also shown excess infant mortality among female babies for certain years, mainly in the northern states of Himachal Pradesh, Uttar Pradesh, Assam, Punjab, Madhya Pradesh, Orissa and Rajasthan. Unfortunately, the available SRS data do not permit any testing of the statistical significance of the observed sex differences.

The recent reports indicate that in the major metropolitan centers of India, the identification of the sex of the fetus through amniocentesis leads to female feticide. Therefore, the sex differences in neonatal and post-neonatal mortality rates need to be watched most carefully.

Postnatal Medical Care:

The postnatal medical care that can influence the chances of survival of babies includes both preventive and curative care. The former category includes well known immunizations such as DPT, polio and BCG. An 'expanded immunization program' was started in India only in 1978 and the current goal is to attain universal immunization by 1989-90, the last year of the Seventh Plan. Immunization centers have been set up in

hospitals, dispensaries, MCH clinics and the PHCs as well as subcenters; but they are to be supplemented by 'outreach operations and campaigns' to cover children who do not visit the fixed centers. As documented by Visaria, the number of children immunized against DPT and polio during 1985-86 was 13.3 and 12.0 million respectively; the corresponding figure for 1975-76, available only for DPT, was 2.4 million. While problems of maintaining cold chain and timeliness of successive doses persist, official statistics suggest that more than half the babies born in recent years have begun to receive immunisations. As the effectiveness of the program improves, it is bound to help lower post-neonatal as well as child mortality.

The issues relating to the availability of curative medical care for sick children are linked with the infrastructure in the form of transport and communications as well as literacy and awareness about sickness and disease. Even here, the simple technology of oral rehydration solution, prepared at home, can make a significant dent in deaths resulting from dehydration following diarrea. The experimental projects of the RUHSA area in Tamil Nadu and the Post-graduate Institute of Medical Education and Research in Haryana have demonstrated the efficacy of this simple strategy (Abel, Chapter 4; Kumar and Datta, Chapter 5).

Of course, public health education in India has a long way to go to make parents recognize the need to consult a health professional. This is an area where the supply of facilities substantially adds to the demand for services. Improvement in these facilities is seen to be contingent upon a sizable public investment, whose unit costs tend to

be high because of the wide scatter or low density of rural population in most states of India, except Kerala where it is difficult to make the distinction between rural and urban areas in most of the state. A large majority of the rural population reportedly consults private physicians whom it considers more dependable despite the expenditure involved. The extent to which the ailments of infants and children lead their parents to spend on medicines and/or health care has not been studied adequately. A considerable amount of empirical research is necessary to identify the possible differences between various socio-economic strata of the population with respect to expenditure on health care of infants. It may also be a function of the birth order and the sex of the child as well as the age of the mother or the parents and the extent of their control over household resources. These issues also remain to be studied but the extent of their correlation with infant mortality has been documented in several papers in this book, and to them we now turn.

Maternal Factors:

Mosley and Chen (1984) included three maternal factors - age, parity, and birth interval - among 14 proximate determinants of child survival. There is a difference of opinion among the contributors to this volume about the desirability of including these maternal factors among the proximate determinants (see Nag, Chapter 14, for a review). These factors are treated separately because they do not 'directly' affect the risk of infant death. Considerable importance has been assigned to these factors in the literature on infant and child mortality. Visaria in

Chapter 2 reviews the available data from hospital records in India on this subject. In addition, seven out of nine chapters based on primary sources of data present results concerning the effect of these factors on infant mortality (see Table 1).

Age and Parity:

Age and parity are usually high correlated and therefore it is difficult to isolate their independent contributions to the risk of infant death. Each of these factors in general show a U-or a J-shaped relationship with infant mortality, i.e. the infant mortality rate is found to be highest at the very young and old ages of childbearing and lower in the middle range- about 20-39 years. Similarly, the infant mortality rate is usually found to be high for the first order and high order births (about 4 and higher parity), and low for the middle range (second to fourth order births). The data presented in Chapter 2 and chapters 6 to 12 provide support to these patterns of relationships, although, perhaps due to the small numbers involved, all of them are not statistically significant. For example, Talwar found the risk of infant mortality among children born to women aged either less than 20 or 40 or more years in rural Madhya Pradesh to be 34 per cent higher than that among children born to women between 20 and 39 years of age. This elevation in risk was found to be statistically significant.

Kanitkar and Murthy make an attempt to disentangle the independent contributions of age and parity to the risk of infant death separately during the neonatal and post-neonatal period. By using multiple classification analysis, they show

that both age and parity affect neonatal and post-neonatal mortality independent of each other; the effect of birth order is less pronounced than the effect of age; and the effect on the risk of neonatal mortality is more pronounced than that on post-neonatal mortality. However, a cross-classification of age and birth order indicated that young women (less than 20 years of age) do not have high parity (4+) births, and women in their forties do not have low parity (1-3) births. With a number of empty cells, a clear-cut attribution of risk to age or parity becomes difficult. Nevertheless, these comparisons indicate that the age of the mother is more important than birth order. Within each birth order category, childbearing among teenagers (less than 20 years of age) is associated with a higher risk of infant mortality than childbearing in the twenties. The risk of infant mortality increases with age thereafter. The highest risk of infant death is observed for fourth and higher parity births among women in their forties followed by first order births among teenagers.

Birth Intervals:

Another factor that confounds the effect of age and parity on infant mortality is the length of the preceding birth interval. Women of any given age can have high parity births only if the interval between births is short. Thus, a higher risk of infant death for fourth or higher parity births in comparison to second and third parity births among women in their twenties can be an artifact of short birth intervals. Kanitkar and Murthy did not control for the effect of short birth intervals.

The effect of birth interval on infant mortality is analyzed by Khan, Ramanujam, Gandotra and Das and Talwar in Chapters 6, 8, 9, and 11, respectively. These results, in general, confirm the expected inverse relationship between infant mortality and birth interval. For example, Talwar shows that in rural Madhya Pradesh the risk of infant death among children born following a birth interval of less than one year is four times the risk among those born following a birth interval of more than one year. Using these data, it can be shown that in comparison to the risk among those born following a birth interval of at least 24 months, there is no elevation in risk among those born following a birth interval of 19 to 24 months; the risk among those born after a birth interval of 13 to 18 months is elevated to 1.6; and the risk among those born after a birth interval of 12 or less months is elevated to 4.0. In spite of the increased risk of infant death following a short birth interval, its contribution to the overall infant mortality rate is not substantial because in rural Madhya Pradesh only 1.2 per cent of the births followed a birth interval of 12 or less months and 8.1 per cent followed a birth interval of 13 to 18 months. If all births took place following a birth interval of 19 or more months, the infant mortality rate would have been 123 instead of 131 deaths per 1,000 births - a reduction of 8 points or 6 per cent.

The role of birth spacing as an important determinant of child survival is increasingly emphasized. This interest stems from the perspective of establishing the health effects of family planning programs. Since birth spacing cannot

directly affect the chances of child survival, the mechanisms through which birth spacing affects child survival are important to understand. A better understanding of these mechanisms will help assess the health benefits of family planning, and would require that the effects of birth intervals be analyzed separately for the neonatal and the post-neonatal mortality rates. This has been done by Khan, Ramanujam, and Gandotra and Das. These authors show that both the neonatal and post-neonatal mortality rates decrease with an increase in the length of the preceding birth interval.

Gandotra and Das used a joint variable obtained by cross-classifying birth order and birth interval variables. Births of first order are classified in one category. Each of the two remaining categories - the second to fourth order births and the fifth and higher order births- are further divided into three categories according to the length of the preceding birth interval -18 or less months, 19-30 months, and 31 or more months. They present both the observed effect of this joint variable as well as its net effect after adjusting for the effects of a number of other factors(such as mother's age and education) on the risks of neonatal and post-neonatal mortality. The results show that irrespective of the birth order, the risks of neonatal and post-neonatal mortality for births following a short interval (18 or less months) are higher than those for births following intervals of 19 or more months. The adjustment for the effects of other factors does not appreciably reduce the effect of birth interval. Among the second to fourth order births, the effect of short intervals on neonatal mortality is more pronounced than that on post-neonatal mortality. However, among the fifth and higher order births, there is not much

difference between the effects of short intervals on neonatal and post-neonatal mortality; the longer birth intervals (31 or more months) are also associated with higher than average risk of post-neonatal mortality. These observations are consistent with the anticipated mechanisms through which birth spacing can influence the chances of child survival.

The effect of birth spacing on neonatal mortality operates through both the biological factors (such as low birth weight and prematurity) and the behavioural factors (such as breast-feeding). The effect operating through the biological factors is likely to be much more pronounced than that operating through the behavioural factors, because the probability of being breast-fed may itself depend upon the birth weight. Although low birth weight may decrease the probability of being breast-fed, it may also independently reduce the chances of survival through the first month. If these premises are correct, short birth intervals should be associated with a higher risk of neonatal mortality irrespective of the order of birth. The results presented by Gandotra and Das demonstrate this mechanism.

The effect of birth spacing on post-neonatal mortality, on the other hand, may operate primarily through the behavioural factors - breast-feeding and other child care variables - both medical and non-medical. The biological disadvantages of short birth intervals that operate through low birth weight disappear with age presumably because of selectivity - weak babies die during early infancy. If so, the effect of short birth spacing that operates through behavioural factors is likely to be much more pronounced among higher order births because the care of the index

child will become more difficult among large families. The results for rural Gujarat presented by Gandotra and Das illustrate this process.

From a policy perspective, shorter birth intervals must be further examined microscopically. Two questions are: how can this interval be increased and what impact will it make? The first question requires a better understanding of why women have short birth intervals and the answer to the second will depend upon the proportion of births that follow a short birth interval.

The interval of less than 18 months should be referred to as 10-18 rather than 0-18 because there cannot be a birth interval of shorter than 10 months in the absence of a premature birth or a stillbirth. The distribution of births and mortality rates within this interval must be studied in shorter segments. The distribution of births within this interval by single months is likely to be skewed toward 16, 17 and 18 months whereas the risk of mortality is likely to be skewed toward 10, 11, and 12 months. If so, the proportion of births exposed to a very high risk of mortality following a birth interval of 10-12 months, as shown by Talwar, is likely to be very small. Their contribution to aggregate mortality nevertheless may be substantial. The relative contributions of these segments within a 'short birth interval' must be established. Factors responsible for mortality following a birth interval of 10-12 months are likely to be different and more difficult to manipulate than those following a birth interval of 16-18 months. A distinction has to be made between short birth intervals resulting from voluntary causes such as a decision not to breast-feed or

not to use contraception and those resulting from involuntary causes such as an early neonatal death or an accidental pregnancy while breast-feeding or using contraception. It is only the women in the first group whose behaviour can be influenced with respect to initiation of breast-feeding or use of contraception.

A number of contributors to this volume present arguments to restrict childbearing to low risk segments - ages 20-39 years, no more than three to four births, and no short birth intervals. What will be the impact of such changes even if ways can be found to change behavior in this direction? The potential impact will depend not only on the relative risks but also on the proportion of births which belong to these high risk categories.

Fifth and higher order births in rural Gujarat, according to the data presented by Gandotra and Das, accounted for 23.7 per cent of all births. Elimination of these births would reduce the infant mortality rate from 109 to 102 deaths per 1,000 births - a reduction of 7 points or 6.4 per cent. Births following a short birth interval (18 months or less) accounted for 11.9 per cent of all births. Elimination of these short birth intervals would reduce the infant mortality rate from 109 to 93 - a reduction of 16 points or 15 per cent. A combination of both, which accounted for 33 per cent of births, would reduce the infant mortality rate from 109 to 91 - a reduction of 18 points or 17 per cent.

These calculations indicate that, in principle, elimination of short birth intervals(less than 18 months), if it can be achieved, would be much more effective in reducing the infant mortality rate than in limiting the number of births to four. Control of fourth and higher parity births may slightly improve the contribution of birth limiting; but unless the risk at first order birth is reduced, the contribution of birth limitation is unlikely to be substantial. It is usually presumed that the increased use of contraception will reduce the proportion of short birth intervals in a country. However, an increase in contraceptive prevalence is generally accompanied by a decline in the incidence and duration of breast-feeding. Perhaps, as a result, the proportion of short birth intervals and first order births does not necessarily decline in countries with high levels of contraceptive use. The development and implementation of effective strategies to reduce the incidence of short birth intervals would, therefore, require a better understanding of the underlying factors. The promotion of family planning will not reduce infant mortality significantly unless the factors causing higher than average IMR among first parity births are identified and tackled.

Household-and Community-level Factors:

The household-level factors include: (1) indexes of socio-economic status of the family such as parent's education, occupation and income; and (2) indexes of household environment such as water, sanitation, and housing condition. The community-level factors include:(1) indexes of the availability of such social amenities as schools, transportation and communication and medical facilities;

(2) indexes of nature and type of the community; and
(3) indexes of social and economic institutions. In addition to understanding the relative importance of these factors from the policy perspective, it is important to understand the mechanisms through which these factors influence the risk of infant death at the individual level and determine the infant mortality rate at the community level.

The information on household-level factors, as shown in Table 1, is analyzed by Khan, Gunasekaran, Ramanujam, Gandotra and Das, and Kanitkar and Murthy. The information on community-level factors is analyzed only by Gunasekaran. Khan, Gunasekaran, and Ramanujam have studied the effect of these factors by taking them one at a time. Gandotra and Das, and Kanitkar and Murthy have used some form of multivariate analysis. In addition, Visaria in her review comments upon the role of female education and work in affecting the risk of infant death, and Jain uses indexes of the household-and community-level factors in explaining the existing regional variations in neonatal, post-neonatal, and infant mortality rates.

The magnitude of the effect of household-level factors on infant mortality (or its components), in general, is quite small and in a number of cases is not significant statistically. Mother's education (and in some cases father's literacy status) and the household's economic status do decrease the risk of neonatal and post-neonatal mortality. These effects are independent of each other and other factors included in multivariate analyses carried out by Gandotra and Das, and Kanitkar and Murthy.

The effect of environmental factors on infant mortality at the household level is not uniform across states. None of the factors considered by Gunasekaran shows a statistically significant effect on infant mortality in rural Madras. Khan's analysis of data from rural UP shows that piped water and concrete flooring in the home are associated with a reduced risk of post-neonatal mortality. Kanitkar and Murthy show that in rural Rajasthan, the observed effect of all the four environmental factors (source of lighting, safe drinking water, flush toilets, and pucca house) is to reduce the risk of infant mortality. The availability of electricity and safe drinking water continues to show independent effects in a multivariate analysis after controlling for the effects of standard of living and mother's age and parity. We, however, do not know whether these effects are statistically significant. Gandotra and Das at the other extreme show that in rural Gujarat, an index of housing condition is associated with a lower risk of neonatal and post-neonatal mortality. These effects are independent of a number of other factors considered by them and are statistically significant. These differences in the effect of environmental factors observed by different contributors may reflect the differences among states in the roles of these factors. Most likely, however, they simply reflect the effect of small numbers included in these studies.

In terms of the mechanisms through which household-level factors influence the risk of infant mortality, these analyses add very little for two reasons. First, the observed effects are quite small and second, the multivariate analyses do not use any analytical or conceptual framework. Gandotra and Das, for example, included eight to nine proximate and

non-proximate factors all together in one multiple regression equation. Kanitkar and Murthy made an attempt to get at the mechanisms but the effort was not successful because of the lack of information on proximate determinants.

The somewhat disappointing outcome concerning the household- and community-level factors is due to the fact that the available data were not specifically collected to shed light on the determinants of infant mortality. Moreover, lack of access to computer facilities in India restricted the scope of these analyses. Obviously, additional micro-level studies are required to identify the determinants of infant mortality. The collection of new data, however, should be guided by the need to test hypotheses concerning the mechanisms. Small in-depth anthropological studies and group discussions, in addition to the literature search, can be very useful in formulating hypotheses to be tested through field surveys.

An important hypothesis that has been generated through, for example, Khan's work on the time-use data of only five pregnant women in rural UP relates to the role of hard labour during the gestation period in determining the survival of infants. His observations show that the work schedule of women in rural UP is 'too strenuous.' They have to work '10-14 hours' per day 'irrespective' of their pregnancy status (gestation period). The infant mortality rate in UP is the highest in the country. The extent to which strenuous work during the gestation period contributes to the observed high infant mortality rate is not known. There are some indications that it increases the risk of infant death.

Another important area of work concerns the role of mother's education. A number of hypotheses, developed by Caldwell and McDonald (1981), are summarized by Visaria in Chapter 2. The analysis undertaken by Jain shows that most of the effect of female education on infant mortality is explained by better medical care at birth and better preventive and curative care during the post-neonatal period. His analysis is based on macro-level data and, therefore, has limitations in terms of its applicability at the micro-level. Evidently, education changes the mother's behaviour with respect to childbearing and rearing but the extent to which these changes can be induced by the expansion of, for example, medical services alone is not clear. It would require analysis of micro-level data on female education, infant mortality, and the availability and utilization of medical services. It would also require additional information on behavioral changes associated with education that are not directly related to the better utilization of medical services. These changes may include better non-medical care of children and better care of the mother herself in general but especially during the gestation period.

POLICY AND PROGRAM IMPLICATIONS

The crucial role of the infant mortality rate as a summary indicator of the level of living and socio-economic development must be recognized in India. In order to tackle the problem of high infant mortality in the country, it is essential to assess and monitor its level in different parts of the country, to better understand the distinct causes of both neonatal and post-neonatal mortality, and to realize the national goal of recording all births and deaths.

The Sample Registration System will continue to be primary source of data on infant mortality. Efforts must be made to prepare estimates at the district or regional level and to tabulate causes of infant deaths, preferably along the lines recommended earlier.

Data collected through special surveys usually remain poorly analyzed. In order to optimize the utilization of these data for research and policy purposes, it is essential to set up a mechanism in the country through which interested professionals in India can have access to the primary data tapes. The analysis and collection of new data should utilize analytical frameworks to test important hypotheses. This process would benefit by the continued and expanded dialogue between health and social scientists concerning the factors that expose newborns to high risk of infection and disease.

The motivation that led to the 1984 seminar on which this volume is based was derived from the differences among health and social scientists concerning the relative importance of socio-economic development and health services in reducing infant mortality rates in India. These differences are not limited to India. Mosley (1983) analyzed child mortality trends and differentials in Kenya and attributed these differentials to differences in maternal education and family income. He underplayed the role of medical interventions. A report based on the 1985 Rockefeller Conference sheds further light on this topic (Halstead et al., 1985). The experiences of four societies - China, Costa Rica, Kerala, and Sri Lanka - were examined at this conference. The report attributed good health to political and social will in Kerala,

Sri Lanka, and Costa Rica, and to political will in China to achieve success in egalitarian distribution of food, and of education and health services. Caldwell (1986) has further investigated the experiences of these populations and other countries and concluded that 'the provision of health services (and, better still, its accompaniment by the establishment of a nutritional floor and perhaps a family planning program) can markedly reduce mortality. In terms of the role of education, Caldwell (1986: 204) concluded that 'education could be said to catalyze that change.'

What can be said about this important policy-relevant topic after sifting through the analysis of the available information from selected community health projects and sample surveys conducted in various states of the country?

The first point that can be made is that the available data are not sufficient to adequately assess the relative importance of socio-economic development and health services for the reduction of infant mortality. For this purpose detailed information is required on the extent and type of health services available in the community and the extent of their utilization by households of different socio-economic strata. Information is also required on the household behavior related to hygienic and sanitation practices, food intake during the gestation period, practices surrounding the birth of a child, and infant feeding practices including breast-feeding and the timing of the introduction of supplementary foods.

Based on the limited information that is available on the subject in India, and based on the deliberations at the seminar, it can be said that a substantial and relatively rapid decline in the infant mortality rate in the country is possible even without a significant improvement in the level of economic development. This assertion is supported by the experience of the state of Kerala in India and the experiences of other countries like Sri Lanka, China and Costa Rica. Community health projects implemented in rural Haryana, Maharashtra, and Tamil Nadu also support this hypothesis. In these areas, a substantial decline in infant mortality was achieved in a short period without substantial improvements in the economic conditions of the population. This does not mean that the advancements in the level of economic development will not have any impact on the infant mortality rate; it simply means that a certain level of economic development is not a prerequisite for reducing infant mortality. Economic development, however, will contribute to the reduction of infant mortality. If the level of economic development in Kerala, for example, was the same as in West Bengal, the infant mortality rate in Kerala perhaps would have been lower than its current level in the state (see Chapter 3).

The roles of social development - as indicated by female education - and health services are complementary as far as their effects on infant mortality are concerned. Under certain circumstances, the effects of these two factors may even be synergistic. Support for these assertions is provided by an analysis undertaken by Nag (1985). He compared the states of Kerala and West Bengal and attributed the lower mortality in Kerala primarily to its higher social

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development and partly to its favourable environmental and hygienic conditions (Nag, 1983:695). Additional support is provided by Jain (1985). He compared the education-specific infant mortality rates for the rural areas of Kerala and Uttar Pradesh and showed that the effect of improvements in both education and medical services is likely to be higher than the 'sum of two individual effects' (Jain, 1985: 188). A multiple regression analysis of 15 major states reported in Chapter 3 also demonstrates the complementarity in the roles of female education and health services in explaining the regional variations in infant mortality. This does not mean that infant mortality cannot decline without improvements in female education. It simply means that improvements in female education will enhance the effect of preventive medical interventions by making them more acceptable and by enhancing the use of available health services for curative purposes.

A substantial and rapid decline in the infant mortality rate especially in high mortality states and, therefore, in the country can be achieved by developing and implementing a two-pronged approach with an emphasis on an effective delivery of essential services, and education and training of personnel. Support for this assertion is provided by the experience of the three community health projects presented in chapters 4, 5 and 6. A multiple regression analysis of the experiences in 15 major states, presented in Chapter 3, also indicates that it may be possible to reduce the high level of infant mortality currently prevalent in many states in India by preventive medical interventions alone.

A minimum package of essential services focussing upon preventive interventions may include : (1) early identification of pregnant women, and provision of antenatal care consisting of tetanus toxoid, adequate nutritious food, and iron and folic acid, and (2) natal and postnatal care consisting of principles of aseptic delivery, early breast-feeding, immunization, timely introduction of supplementary foods, and, perhaps, growth monitoring. Data on each of these interventions are not presented in this volume. A good case, however, can be made about each of them.

The likely important role of immunization of pregnant women is evident from the cause of death data assembled in Chapter 2 which indicate that 14 per cent of infant deaths in rural India and 7 per cent in urban India in 1978 were reported to be due to tetanus. The prevalence of tetanus is also reported in micro-level studies. The provision of tetanus toxoid during the gestation period and/or ensuring the adoption of aseptic delivery procedures can virtually eliminate these infant deaths. The impact of these simple interventions in areas of high tetanus on infant mortality will be quite substantial. In areas without tetanus, however, these interventions will not reduce the level of prevailing infant mortality. This is demonstrated by the experiences in Vadu project area (see Chapter 6). Similarly, the effect of immunization on post-neonatal mortality is demonstrated by the state-level analysis in Chapter 3 and by the household-level analysis in chapters 8 and 10.

The practice of breast-feeding in India is believed to be almost universal and prolonged. Yet the level of infant mortality is high. Two seasons contributing to this anomaly might be the practices related to the delay in initiating

breast-feeding, and delay in the introduction of supplementary food. Available information on these practices, presented in Chapter 2, suggests that in a majority of cases, women delay the initiation of breast-feeding by as much as two to three days because they believe that the initial milk is not good for the newborns. There are also widespread practices of introducing prelacteal feeds. Both these practices increase the risk of infection. Although there is no empirical information at the household level about the effect of these practices on infant mortality, changes in them are most likely to increase the chances of child survival.

In education and training programs, efforts must be made to ensure that the messages conveyed through the various channels of communication are mutually reinforcing, and not contradictory and confusing. Such programs are needed for (a) the doctors serving in the primary health centers as well as the private practitioners, (b) the paramedical personnel, (c) the trained and untrained birth attendants, (d) mothers, and (e) various organizations which have an established rapport with the people and the capacity to influence their behavior.' The existing manuals of recommended practices need to be reviewed and revised to make the messages consistent and reinforcing. These messages for health personnel and mothers should include the importance of immunizing pregnant mothers against tetanus, immunization of children against DPT and measles, training the mother to treat diarrhea with oral rehydration salts, and elimination of discrimination against daughters and women in the delivery of health care and allocation of food.

The high-risk mothers produce high-risk babies and therefore they should be identified; adequate referral and provision of remedial services should be provided to help mothers and infants at risk. The paramedical personnel and the birth attendants must be trained to identify mothers exposed to a relatively high risk of infant death. These mothers can be identified on the basis of the presence of multiple risk factors such as a previous history of complications of pregnancy, anemia, general malnutrition based on their height and weight, a tendency to have high blood pressure, age(below 18 and 35 and above), and parity (first or fourth and higher). Such a screening process would help the paramedical personnel in arranging referrals to a doctor or other institutions providing maternity care on a selective basis, without spreading the limited resources thinly over all pregnant women. Such a selective approach would also help to ensure that priority attention is given to the most needy mothers, although certain basic care and services must be made available to all mothers and babies.

The quality of services provided to the high-risk mothers is as important as the early identification of these mothers. The social perceptions and concern for the health and survival of women are also crucial for detecting and treating the complications and problems at various stages.

Provision of family planning services, especially for spacing pruposes, must be added to the interventions aimed at the reduction of infant mortality. Evidence concerning the effect of short birth intervals and high parity has been reviewed earlier in this chapter. As mentioned earlier, the development and implementation of effective strategies

to reduce the incidence of short birth intervals requires a better understanding of reasons why women bear children close together in the first place. Provision and promotion of contraceptive methods for spacing would help to reduce the infant mortality rate to the extent that the adoption of contraceptive methods reduces the incidence of short birth intervals.

In terms of practical steps, there is an urgent need to launch an intensive effort to raise child survival in the most backward areas, where high infant mortality and low acceptance of family planning methods exist. In addition, high neonatal mortality warrants special attention to the newborn as a part of the postpartum program to promote family planning. The requisite services can also be made a part of the expanding health care delivery infrastructure under the integrated child development services scheme (ICDS). The attitude toward newborn babies needs to change; infants should not be separated from mothers after birth for long periods because such separations tend to delay the onset of breast-feeding. It is also necessary, through the promotion and use of staff incentives, to ensure that the maternal and child health activities do not suffer during the periodic drives to achieve family planning targets.

A large number of activities that are needed to improve the chances of infant survival are at least potentially within the control of women and communities themselves. It should, therefore, be possible to make a significant dent in high infant mortality primarily through the following actions, which can be taken immediately:

- Prevention of neonatal tetanus through immunization of pregnant mothers and through extensive use of safe delivery kits distributed to paramedical personnel or to mothers;

- Promotion of correct breast-feeding practices. Efforts should be made to educate women to initiate breast-feeding immediately after birth and to depend upon it completely until the infant is about six months of age. At the same time, women must be educated to introduce supplementary solid foods at the right time during the first year of life;

- Increased coverage of immunization of children (including measles) and use of home-based treatment of diarrhea.

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* This Overview has been excerpted from recent book by Drs Anrudh K Jain and Pravin Visaria, entitled "Infant Mortality in India: Differentials and Determinants". Annotations and references relate to various chapters of that book.